Radio Spectrum Measurement System Upgrades

Outputs

- Uncertainty analysis of RSMS-3 measurements.
- Upgrade of ITS preselector hardware design.
- Functional Measurement Requirements document for RSMS-4.

The Radio Spectrum Measurement System (RSMS) evolves on a yearly basis. Although the Department of Commerce operated vehicle-mounted radio measurement systems as early as the 1920's (Figure 1a), the first such Department of Commerce system of the modern era (RSMS-1) was developed in the mid-1970's and was mounted in a motor home body (Figure 1b). This system provided the first computer-controlled measurements of spectrum occupancy up to 12 GHz, making a detailed statistical description of mobile radio channel usage possible.

A second version, RSMS-2, was designed and developed in the early 1980's and housed an entirely new measurement system in the same motor home body. RSMS-2 provided improved RF sensitivity and measurement capabilities up to 18 GHz in two independent computer-controlled systems. The current version, RSMS-3 (Figure 1c), holds two independent 22-GHz systems mounted in a smaller shielded 4-wheel-drive vehicular configuration, taking advantage of significant advances in commercially available measurement instrumentation and computers.

The RSMS designs have been continually upgraded to keep pace with developments in radio measurement technology, computer control technology, and the changing environment of the radio spectrum. Since the 1970's each version has lasted approximately a decade before requiring major modifications and improvements. In FY 2002, a new RF front end was designed for the RSMS, featuring improved signal handling capabilities.

ITS is currently developing a fourth generation RSMS (RSMS-4). As described in the following sections of this report, the RSMS-4 ushers in the new century and continues the 80-year-long tradition of Department of Commerce mobile radio systems with the development of a state-of-the-art system.

Figure 1a. Original Department of Commerce Radio Measurement Vehicle, 1927.

Figure 1b. First and second generation of modern RSMS (1970s and 1980s) used the same vehicular chassis.

Figure 1c. Third generation RSMS (1990s onward).

Initial efforts were directed toward developing a Functional Measurement Requirements document, (http://www.its.bldrdoc.gov/home/programs/rsms-4/functional_req_v2.pdf) after which the project was split into three areas of development: vehicle, RF and measurement hardware, and software. The Functional Measurement Requirements spell out the kinds of measurements that are expected and desired for RSMS-4 and provided the foundation for decision making in every aspect of the three areas of development.

In FY 2002, with the RSMS-4 under development, a detailed analysis was undertaken in the RSMS Enhancement Program to quantify uncertainties in the RSMS gain calibration routines. This analysis provides the basic foundation needed to compute the uncertainty of RSMS power measurements. In particular, the analysis is a first step towards quantifying, rather than simply estimating, the RSMS system's ability to perform absolute field strength measurements. A quantitative uncertainty budget is needed when making comparisons between data gathered from independent experiments. Without this kind of information it is not possible to evaluate whether a difference between experimental values indicates a discrepancy, or is an artifact of the test process. An added benefit of this work is that it provides an insight into how the RSMS test equipment and measurement routines can be configured to obtain the best possible system performance.

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